A5 Cont

being insulated from the ferrite form and wound about the ferrite form thereby creating an impulse noise choke.

A6

19. The method of Claim 18 wherein the RF choke comprises a ferrite form; and a solid grounding conductor having first and second ends, an insulated outer surface and a cross-section of sufficient size to function as a suitable ground for the coaxial network, the conductor being wound about the toroid.

A7

22. (new) A filter for reducing RF interference on a coaxial network, the filter comprising:

a solitary ferrite form; and

a conductor having first and second ends, the conductor being wound about or through the ferrite form thereby creating a choke in series between the first conductor end and the second conductor end; and

a terminal coupler provided at one of the conductor ends for electrically coupling the choke between a coaxial network ground block and a ground reference source.

REMARKS

The Examiner has objected to the disclosure on the grounds that it is not clear whether the phrase "ferrite Number Seventy-Seven" as used on page 9, line 9 of the specification is a trademark. Applicant's Attorney conducted a search of the U.S. Patent and Trademark Office records for any marks incorporating the term "ferrite" and only uncovered two such marks, namely FERRITE NOISE TRAP and THE FERRITE FENCE. A copy of the search is enclosed for the Examiner's consideration. Applicant respectfully submits that type 77 ferrite material is not a trademark, but rather a standard use in the industry for identifying ferrite material having certain properties and made of manganese-zinc. A copy of webpages from a website located at www.bytemark.com evidencing the same is enclosed for the Examiner's consideration. Applicant has amended the phrase "ferrite Number Seventy-Seven" in the specification to "type 77 ferrite material" to clarify the same.

The Examiner objected to claims 3, 4, 5, 6, 11, and 17 under 35 USC § 112 for various reasons. In particular, claims 3, 4, 5 and 6 were objected to on the grounds that the limitation "the toroid" does not have sufficient antecedent basis. Applicant has amended claims 3-5 to replace the limitation "toroid" with the limitation "ferrite form" as recited in claim 1 to provide such antecedent basis. This amendment is fully supported by the specification and in particular, page 9, lines 9-11 thereof. The amendment clarifies the claims, but does not narrow the scope of any of the claims.

Claims 5, 11, and 17 were objected to for containing the language "type 77 ferrite." As previously stated herein, this term is not a trademark or tradename, but the generic label for a particular type of ferrite material well known in the industry. Accordingly, Applicant respectfully submits that no amendment to this language is necessary.

The Examiner rejected claims 1-4, 7-9, 12-16, and 18-21 under 35 USC § 102(b) as being anticipated by U.S. Patent No. 5,091,707 to Wollmerschauser et al. ("Wollmerschauser"). A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegall Bros. v. Union Oil Co. of California,* 814 F.2d 628, 631, USPQ2d 1051, 1053 (Fed. Cir. 1987). When a reference is silent about the asserted and inherent characteristics, the Examiner must present evidence which makes clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by a person of ordinary skill. *Continental Can Co. USA v. Monsanto Co.*, 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749 (Fed. Cir. 1991).

To begin with, Applicant notes, as specifically stated in the Background of the Invention section of the present application (in particular, page 5, lines 28-34), that the filter disclosed in Wollmerschauser is ineffective for use as a grounding conductor for a typical coaxial network. In fact, the only reference to the term "ground" in the Wollmerschauser patent is the use of the term "background" in the section entitled "Background of the Invention." Rather, the filter as described in Wollmerschauser cannot attenuate RF signals in the frequency range used for return or upstream signals without loss of ground functionality. Both attenuation and grounding can only be met by the filter having the structure set forth in independent claims 1, 8, 13 and 18 and the remaining claims that depend therefrom. Applicant has amended independent claims 1 and 8 to further clarify that the conductor is of a grounding type.

With respect to independent claim 1, while Wollmerschauser discloses a conductor 12, it is not a grounding conductor as required by claim 1 as amended. Moreover, while Wollmerschauser discloses a terminal coupler, 24, it is not one that electrically couples a choke between a coaxial network ground block and a ground reference source as required by amended claim 1. Wollmerschauser also fails to disclose a conductor connected in series with a coaxial network ground block and ground reference source as required by claim 1.

With respect to claim 2, the Examiner states that Wollmerschauser discloses a filter for reducing RF interference on a coaxial network wherein the solid conductor inherently

functions as a ground for the coaxial network and attenuates RF interference to this configuration. The Examiner's inherency rejection is inappropriate for several reasons. First, the inherency rejection is not specific. "[W]hen an examiner relies on inherency, it is incumbent on the examiner to point to the 'page and line' of the prior art which justifies an inherency theory." *Ex parte Schricker*, 56 USPQ2d 1723, 1725 (Bd.Pat.App & Interf. 2000); see also *In re Rijckaert*, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993)("when the PTO asserts that there is an explicit or implicit teaching or suggestion in the prior art, it must indicate where such a teaching or suggestion appears in the reference."). In the present case, the Examiner has not identified the specific portions of the Wollmerschauser patent that justifies the inherency theory. Thus, the inherency rejection has not been sufficiently presented by the Examiner.

Second, the Examiner has not made a reasonable showing that the inherency rejection is supportable. In *Ex parte Skinner*, 2 USPQ2d 1788, 1789 (Bd.Pat.App & Interf. 1986), the Board stated:

> "[W]here an examiner has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, the examiner possesses the authority to require an applicant to prove that the subject matter shown to be in the prior art does not possess the characteristic relied on. Nevertheless, **before an applicant can be put to this burdensome task, the examiner must provide some evidence or scientific reasoning to establish the reasonableness of the examiner's belief that the functional limitation is an inherent characteristic of the prior art**. In the case before us, no such evidence or reasoning has been set forward."

(emphasis added). In the present case, all that the Examiner has said concerning inherency of the Wollmerschauser patent is that the solid conductor "inherently functions as a ground for the coaxial network and attenuates RF interference due to its configuration." The Examiner's statement is neither evidence nor a reference to any evidence. The Examiner's statement is also not scientific reasoning. No reason is given how Wollmerschauser's disclosure of a conductor generally makes inherent Applicant's claimed filter. "It is by now well settled that the burden of establishing a prima facie case of anticipation resides with the Patent and Trademark Office." *Id.* at 1788-89. The Examiner's deficient inherency rejection does not constitute a prima facie case of anticipation.

Third, not even the broad concept of a filter having a grounding conductor or one electrically coupled between a coaxial network ground block and a ground reference source is inherent in the Wollmerschauser patent. An element of a claim is not "inherent" in a prior art

reference unless extrinsic evidence clearly shows that the missing descriptive matter is "necessarily present in the thing described in the reference." *In re Robertson*, 49 USPQ2d 1949, 1950 (Fed. Cir. 1999). Again, as expressly stated in the specification of the present application, coaxial cable does not meet electrical code requirements for use as an acceptable ground wire (see specification, page 5, lines 33-34). Therefore, the filter of Wollmerschauser is ineffective for use as a grounding conductor for a typical coaxial network. Rather, if the Wollmerschauser conductor were connected to a common ground shared by the coaxial network, which Applicant again stresses is nowhere disclosed in Wollmerschauser, a path would be created for impulse noise and other undesired RF signals to enter the coaxial network thereby increasing RF interference, not attenuating it as required by claim 2. Applicant submits that for the reasons mentioned above, a grounding conductor as required by amended claim 2 cannot be found to be necessarily present in the filter of Wollmerschauser.

With respect to claims 3, 4, and 7, they all depend from claim 1 and for the reasons set for above, Applicant respectfully submits that these claims are also not anticipated by Wollmerschauser.

With respect to claim 7 in particular, the Examiner states that Wollmerschauser discloses a threaded receptacle 28 for receiving a ground wire from the ground reference source. However, Applicant can find no such disclosure in Wollmerschauser. Again, the only use of the term "ground" in the entire patent is the use of the term "background" in the title of the "Background of the Invention" section. Neither a ground wire nor a ground reference source is ever mentioned in Wollmerschauser. As a result, Applicant respectfully submits that this rejection is completely unfounded.

With respect to claim 8, it has been amended to clarify that the conductor is a grounding conductor that as previously stated above is not expressly or inherently disclosed in Wollmerschauser. With respect to claims 9-12, they all depend from claim 8 and for the reasons set forth above, Applicant respectfully submits that these claims are not anticipated by Wollmerschauser.

With respect to claim 9 in particular, it further requires a choke configured to function as a sufficient ground for the coaxial network ***and*** to attenuate RF signals. As previously stated, the filter as disclosed in Wollmerschauser is not configured to function as both a sufficient ground for a coaxial network and to attenuate RF signals as required by claim 9.

With respect to claim 12 in particular, Applicant notes that it requires a terminal coupler configured to join the coaxial network to the first conductor end with a ground wire and whenever the second conductor protrudes through the housing for attachment to a ground block source. As previously stated herein, Wollmerschauser fails to disclose either expressly or inherently the ground wire and ground block source connections as required by this claim.

With respect to claim 13, it requires an RF choke connected in series between a ground reference source and the coaxial cable outer shield. Again, no such series connection or ground reference source is disclosed, expressly or inherently, in Wollmerschauser.

With respect to claims 14-16, they depend from claim 13 and for the reasons set forth above, Applicant respectfully submits that these claims are not anticipated by Wollmerschauser.

With respect to claim 18, it requires (1) grounding the coaxial shield of the coaxial cable of the coaxial network at the second site through a ground wire connected between the shield and a ground reference source, and (2) connecting an RF choke in series with the shield and the ground reference source. As previously stated herein, neither a ground reference source, nor a series connection of an RF choke thereto is disclosed in Wollmerschauser as required by this claim.

With respect to claim 19, as amended, it requires a grounding conductor configured to function as a suitable ground for the coaxial network. As previously mentioned, no such grounding conductor is disclosed, either expressly or inherently in Wollmerschauser.

With respect to claim 20, it requires an RF choke comprised of a ferrite form adapted to be placed around a ground wire. Again, neither a ground wire nor such a configuration is disclosed in Wollmerschauser.

With respect to claim 21, it requires (1) grounding a coaxial shield at the second site through a ground wire connected between the shield and a ground reference source, and (2) connecting an RF choke in series with the shield and the ground reference source. Again, neither a ground reference source nor such a series connection is disclosed in Wollmerschauser.

The Examiner also rejected claims 5, 11 and 17 under 35 USC § 103(a) as being unpatentable over Wollmerschauser in view of U.S. Patent No. 606,049,2582 Fawal et al. ("Fawal"). Again, for the reasons set forth above, Applicant respectfully submits that Wollmerschauser fails to disclose a filter as set forth in claims 1, 8, and 13 from which these claims depends and thus, respectfully requests that the rejection be withdrawn.

Claim 6 is rejected under 35 USC § 103(a) as being unpatentable over Wollmerschauser on the grounds that is well known in the art that the gauge of the conductor determines the current-carrying capability of the conductor. Again, for the reasons set forth above, Applicant respectfully submits that Wollmerschauser fails to disclose a filter as set forth in claim 1 from which this claim depends and thus, respectfully requests that this rejection be withdrawn.

Claim 10 is rejected under 35 USC § 103(a) as being unpatentable over Wollmerschauser in view of U.S. Patent No. 4,701,726 to Holdsworth ("Holdsworth"). In particular, the Examiner concludes it would have been obvious to have modified the filter of Wollmerschauser to incorporate a ground block based on Holdsworth. The Holdsworth patent, however, has nothing to do with the reduction of interference in a transmission system using coaxial cables. Rather, the trap filter (which comprises the ground block) is used to block a particular channel or band of channels within a video cable system. Moreover, the ground block disclosed in Holdsworth is used to isolate the filter areas 16 and 18 of the trap filter from one another so that the respective housing halves 34 and 44 can be tuned separately. There is absolutely nothing in the Holdsworth patent to suggest that the ground block is attached to an impulse noise choke. In light of the foregoing and for the reasons set forth above with respect to claim 8 from which this claim depends, Applicant respectively submits that this rejection is unfounded and respectfully requests that it be withdrawn.

Applicant has added claim 22, which further distinguishes the present invention over the prior art of record. None of the prior art of record discloses a filter as set forth in claim 22 having a solitary or single ferrite or toroid form. In particular, Wollmerschauser discloses two toroid forms (see Figure 1, and column 4, line 66 through column 5, line 14). The Patent and Trademark Office is hereby authorized to charge the amount of $40.00 for this additional claim to Deposit Account No. 20-0823.

Based on the foregoing, Applicant respectfully submits that the application is in a condition for allowance and notification to that effect is earnestly solicited. If there are any outstanding issues, the Examiner is urged to contact the undersigned at the number listed below. Applicant does not believe this amendment requires the payment of any additional fees, except for newly added inducement claim 22. Nevertheless, the Patent and Trademark Office is hereby authorized to charge any deficiencies or credit any overpayment to Deposit Account No. 20-0823.

Respectfully submitted,

Thompson Coburn LLP

Date: May 27, 2002

By: ______________________

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ATTORNEYS FOR APPLICANT

MARKED UP VERSION OF SPECIFICATION

Page 6, lines 9-15

In addition to attenuating RF signals, another problem which has developed is the effects of drop passive devices such as splitters and couplers that have ferrite transformers "magnetized" due to current flow in the ground path as fully set forth in the position paper of Scientific Atlanta on Drop Passive Non-Linearity created on or about April 6, 1998, the disclosure of which is expressly incorporated herein by reference. The filter of the present [connection] invention tends to correct the effects of the ferrite magnetization when such magnetization is caused by impulsive or surge current in the ground path.

Page 9, lines 9-20

Secured in the housing interior 14 is a toroid or toroid form 22 consisting of type 77 ferrite material [Number Seventy-Seven] or similar performing material. The toroid may be of any suitable ferrite material to accomplish the attenuation of the frequencies of interest. In the preferred embodiment of the invention, the toroid form 22 is secured in the housing interior 14 by an epoxy material (not shown). However, the toroid form 22 may be secured in the housing by any other equivalent means. In the preferred embodiment, wrapped around the toroid form 22 is an insulated solid conductor 24. The coils 26 of conductor 24 wrapped around the toroid form an RF signal choke 28 of the filter. The choke 28 functions as an inductor connected in series between the coaxial outer shield and a ground source (not shown). Although the preferred embodiment uses an insulated solid conductor 24, an alternative embodiment could use a toroid form which is insulated in combination with an uninsulated conductor. In such an embodiment, the individual wraps of the uninsulated conductor should not contact one another.

MARKED UP VERSION OF CLAIMS

1. A filter for reducing RF interference on a coaxial network, the filter comprising:

a ferrite form; and

a solid grounding conductor having first and second ends, the conductor being wound about or through the ferrite form thereby creating a choke in series between the first conductor end and the second conductor end; and

a terminal coupler provided at one of the conductor ends for electrically coupling the choke between a coaxial network ground block and a ground reference source.

3. The filter of Claim 2, wherein the [toroid] ferrite form is constructed of ferro-magnetic material.

4. The filter of Claim 3 wherein the [toroid] ferrite form attenuates RF signals in a frequency band from approximately 5 MHz to approximately 42 MHz.

5. The filter of Claim 3 wherein the [toroid] ferrite form is constructed of type 77 ferrite material.

8. A filter for reducing impulse noise in a coaxial network wherein the impulse noise is being introduced into the coaxial network through a coaxial network ground wire, the filter comprising:

a ferrite form; and

a solid grounding conductor having first and second ends and a cross-section of sufficient size to function as a suitable ground for the coaxial network, the conductor being insulated from the ferrite form and wound about the ferrite form thereby creating an impulse noise choke.

19. The method of Claim 18 wherein the RF choke comprises a ferrite form; and a solid grounding conductor having first and second ends, an insulated outer surface and a cross-section of sufficient size to function as a suitable ground for the coaxial network, the conductor being wound about the toroid.

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MAGNETIC PROPERTIES OF FERRITE MATERIALS

(This table is 760 pixels wide)

Material Type	77	83	F	J	K	W
Initial Perm.	2000	300	3000	5000	290	10, 000
Max. Perm.	6000	3600	4300	9500	400	20, 000
Max. Flux den. @ 10 oer. (gauss)	4600	3900	4700	4300	330	4300
Residual Flux density (gauss)	1150	3450	900	500	250	800
Vol. Resis. (ohms-cm)	1×10^2	1.5×10^3	1×10^2	1×10^2	20×10^7	15×10^2
Temp. Coeff. -20°C - 70°C (%/°C)	.25%	.4%	.25%	.4%	.15%	.4%
Loss Factor	4.5×10^{-6} @ 0.1 MHz	50×10^{-6} @ 0.1 MHz	4×10^{-6} @ 0.1 MHz	15×1^{-6} @ 0.1 MHz	28×10^{-6} @ 1 MHz	7×10^{-6} @ 10 MHz
Coercive Force (Oersteads)	.22	.45	.20	.10	1	.04
Curie Temp. ° C	200	300	250	140	280	125
Resonant Cir. Freq. (MHz)	1 KHz to 2 MHz	1 KHz to 5 MHz	1 KHz to 1 MHz	1 KHz to 1 MHz	0.1 KHz to 30 MHz	1 KHz to 250 MHz
Wide band Freq. (MHz*)	.5 to 30 MHz	1 to 15 MHz	.5 to 30 MHz	1 to 15 MHz	50 to 500 MHz	1 KHz to 1 MHz
Attenuation RF Noise (MHz)	1 to 40 MHz	.5 to 20 MHz	1 to 20 MHz	0.5 to 10 MHz	200 to 5, 000 MHz	100 KHz to 1 MHz

* Based on low power, small core application. Listed frequencies will be lower with higher power.

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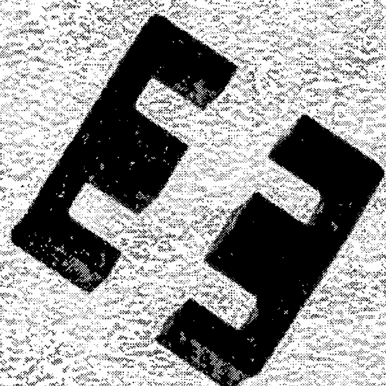
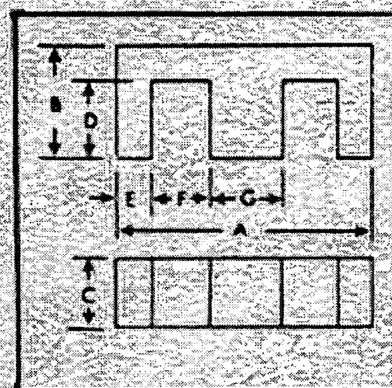
E-Cores are available in the 77 (stocking) and J (non-stocking) Material.

Type 77 Ferrite Material
permeability 2000

These are ideally suited for low power applications up to 200 watts. A nylon bobbin is supplied for easy winding. Please see section IV on "Toroid Mounts & E-Core Bobbins" for more information on different types of E-Core Bobbins.

E-Core Physical Dimensions (inches)





Part No.	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*Power*
EA-77-188	.760	.318	.187	.225	.093	.192	.187	10 watts
EA-77-250	1.000	.380	.250	.255	.125	.250	.250	20 watts
EA-77-375	1.375	.562	.375	.375	.187	.312	.375	70 watts
EA-77-500	1.625	.650	.500	.405	.250	.312	.500	100 watts
EA-77-625	1.680	.825	.605	.593	.234	.375	.468	200 watts

E-Core Magnetic Properties

Part No.	A_e mm^2	l_e mm	V_e mm^3	A_s mm^2	A_W mm^2	$A_C x A_W$ mm^4	A_L *value* *mh/1000 turns*
E-77-188	22.5	40.1	900	1050	55.7	1250	1060
E-77-250	40.4	48.0	1930	1700	80.6	3250	1660
E-77-375	90.3	68.8	6240	3630	151.0	13700	2760
E-77-500	160.0	76.7	12300	5410	163.0	26100	4470
E-77-625	184.0	98.0	18000	7550	287.0	52900	5300

Wire Size vs. Number of Turns

wire size>	*18*	*20*	*22*	*24*	*26*	*28*	*30*	*32*	*34*	*36*	*38*
EA-77-188	21	33	50	79	125	196	293	439	669	1046	1548
EA-77-250	34	62	93	147	232	364	532	814	1240	1938	--
EA-77-375	63	94	149	235	372	582	868	1302	1984	--	--
EA-77-500	50	141	212	335	532	829	1236	1855	--	--	--
EA-77-625	159	250	375	593	939	1470	2191	--	--	--	--

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Editor's Note: *antenneX* is an authorized distributor of many f the Palomar Engineers' pr ducts n a selected basis that are considered useful f r its radio-related readership. The Ferrit Beads Kit and Balun Kits have now been added t the shelves in the Shopping Shack f r online purchases and for your convenience.

Using Ferrite Beads to Keep RF Out Of TV Sets, Telephones, VCR's, Burglar Alarms and Other Electronic Equipment

RFI and TVI have been with us for a long time.
Now we have microwave ovens, VCR's and many other devices that do wrong things when they pick up RF.

There are several ways to tackle the problem but most of them involve opening the affected equipment and adding suppressor capacitors, filters, and other circuit modifications. Unfortunately there is a serious disadvantage associated with this approach. Any modifications made to domestic entertainment equipment can - and often are - blamed for later problems that arise in it. Modifying your own equipment is not so bad, but taking a soldering iron to your neighbor's stereo is risky. An alternative approach is to use ferrite beads to reduce the amount of RF entering the equipment. If the equipment is in a metal box, or even if it's in a plastic box, if RF is prevented from entering the box on the antenna lead, the power cable, the speaker leads, the phono pickup leads, and on any other wires entering the box, it is possible to solve the problem without any modification to the equipment. Ferrite beads just slip over the wires and stop RF from going in.

Ferrite beads are made of the same materials as the toroid cores used in broadband transformers but are used at much higher frequencies. For example, ferrite Mix 43 is used for tuned circuits in the frequency range .01 to 1 MHz. It is efficient and losses are low. But, if it is used in the 1-1000 MHz range it is lossy. So when you slip a bead of Mix 43 over a wire and there is RF in the 1 -1000 MHz range going down the wire, it is just as though you put a resistor in the wire. But you did not have to cut the wire to insert the resistor; you just slip a bead over the wire. If the resistance of one bead is not enough you can add more beads or add longer beads to get more resistance. The beads, unlike a resistor, do not affect the wire at low frequencies so the audio, DC, and other low frequency components go through the wire just as though the bead were not there.

There are three bead materials in general use: Mix 77, Mix 43, and Mix 64. Mix 43 is the best for all-round use. It works from 1 to 1000 MHz. Mix 77 is a little better at the lower frequencies, so if your major problems are on 80 and 160 meters use it. Mix 64 is a little better on the higher frequencies so if your problems are mostly on two meters and up use it.

It is important to remember that the frequencies mentioned are those of the interfering signals to be eliminated, not the operating frequencies of the equipment being protected. For example: To protect a telephone operating at voice frequencies of .002 MHz we use type 43 or 77 beads to keep 14 MHZ RF out.

So when you buy beads you must specify both the physical size (FB-3, FB-8, etc.) and the material (Mix 77, Mix 43, etc.) depending on the frequency of the RF interference. FB-1, FB-3, and FB-7 have .05" holes that will slip over bare #18 gauge wire. FB-8 has a .09" hole and will slip over the insulation of #22 wire. FB-24 and FB-63 have .2" holes to go over larger wire or cable. FB-56 has a 1/4" hole to clear RG58/RG-59/RG-58X. FB-102 and FB-124 have 1/2" holes to clear RG-8/RG-11.

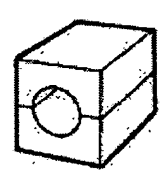
Cables. So far we have talked about slipping beads over individual wires. But, in many cases, we are going to find two wire speaker cables, two wire or three wire power cables, twinlead antenna cable, and multi-wire control cables. Cable wires are close together and act just like a single wire as far as RF pickup is concerned. So the whole cable can go through the bead and this will suppress RF transmission through all the cable-wires. This is a lot easier than putting beads on each wire.

Twinlead is a special case. If you put a bead on each wire you'll kill the TV signal. But if the whole twinlead goes through a single bead, the TV signal goes on through but the RF interference is suppressed by the bead. This is because the twinlead is a transmission line to the TV signal but looks like a single wire to the RF interference.

This brings us to coaxial cable. The signal going through the coax is confined to the inside of the coax shield. But the outside of the shield acts just like any wire; it can pick up RF and that RF can be carried to the TV or monitor. Shield beads placed over the cable will suppress this interference.

Toroids. When we start talking about slipping beads over coaxial cable and multi-wire cable we see that we may need beads with pretty big holes. Also, if the cable has a molded plug on the end (like some power cords, for example) the plug has to go through the hole and we may need a very big hole indeed. Fortunately a variety of ferrite toroid cores are available with holes as big as 1.4" diameter. They are not available in all the same materials as beads but in similar ones. As a guide when specifying toroids for RF suppression: Mix 43 is the best for all-round use. It works from 1 to 1000 MHz. Mix 77 is a little better at the lower frequencies, so if your major problems are 80 and 160 meters use it. Mix 61 is a little better on the higher frequencies so if your problems are mostly on two meters and up use it.

After you put that big plug through the toroid hole you'll find that the toroid fits the cable very loosely. Don't worry. It will still work fine. If there is room to do it, loop the cable around and run it through the toroid again. Do this as many times as you can. Each turn is just like adding another toroid. And, using the big Mix 61 cores, you add an inductive choke where two turns is four times as good as one turn, three turns is nine times as good, etc.



Split Beads. This is a new development to solve the problem of putting beads or toroids over cables that have big plugs on the end. They are beads that have been cut in half. You put the two halves over the cable and wrap them with tape to hold them together. The mating edges are polished smooth so the two halves mate very closely.

They are available with center holes of 1/4" and 1/2' diameter. Also for flat computer cable 2 or 2-1/2" wide. It is important that the two halves of the split beads fit exactly together. So the 1/2" hole beads cannot be used for cables larger than 1/4". It does not matter if the cable is smaller than the hole. All split beads now available are of 43 material which is the best overall

material for 1-1000 MHz interference suppression.

Telephone Interference. The standard telephone is highly susceptible to RFI. The telephone wiring in the house and outside on poles make a large receiving antenna. And in the telephone instrument are voltage-variable resistors that act like detector diodes so nearby radio stations are clearly heard. The solution is to keep RF out of the telephone by putting ferrite beads on the telephone cable as it enters the instrument. The plug of modular telephones will go through F82 toroids. Unplug the wire from the telephone, put it through the hole of the toroid (three or four times if there is room) and plug it back into the telephone. Or use a split bead.

Burglar Alarms. These are much like telephones in that they have extensive wiring throughout the building that acts like an antenna to pick up RF. The solution is the same: Use beads or toroids on the wire entering the electronics box to keep RF out. It also may be necessary to put beads on the 115-v AC power cord.

TV Sets. Put a bead or toroid on the power cord as it enters the set. Toroids or split beads on the antenna cable also may be needed.

VCR's. The VCR is a real RFI problem. Ferrite beads on all wires entering the VCR can eliminate RFI from most amateur bands. But on 80 meters even this doesn't always work. It may be necessary to shield the VCR housing to completely eliminate RFI.

Stereo. Long speaker wires can act like an antenna to pick up RF and feed it into the output of the amplifier. The amplifier's feedback circuit allows the RF to reach the input where it is rectified, amplified and then heard in the speaker. The solution is to use beads on the speaker wires just as they leave the amplifier. RF can enter the stereo system through the power cord. Use a split bead or a toroid on the cord just as it enters the stereo.

We have been talking about keeping RF out of equipment. You can also use beads and toroids to keep RF in. That fish tank heater that makes all that racket on 80 meters is using its power cord and the house power wiring to radiate interference. A bead or toroid on the power cord right at the heater can keep the noise from entering the wiring. Computer power cords and connecting cables can be treated in the same manner. Sometimes RF comes out of a transceiver's power cable. A toroid can stop it. Or RF flows on the outside of the antenna cable, going right around your lowpass filter. Again, toroids to the rescue.

Computers. Computers are a part of many modern amateur radio stations. Often they are directly connected to the transceiver for RTTY, packet and other digital modes. They aiso are used for contest scorekeeping and other uses. Computers generate RFI because they use digital waveforms in the high frequency band that have high harmonic content. They can cause interference throughout the shortwave band and even into VHF.

Some of the interference is radiated from the circuit boards but the most common source is interference conducted out of the computer on the many cables that connect it to its monitor, its keyboard, its printer, and the radio or its data controller interface.

To get rid of the interference, it is helpful to try to find which cable it's coming out of. Start by tuning in the interference and writing down the "S" meter reading. Then disconnect, one at a time the devices connected to the computer and as you do so note any change in "S" meter level. Disconnect the printer, the modem, the keyboard, the mouse, the monitor, the data

controller, and anything else connected to the computer. Hopefully this procedure will give a good clue as to where the problem lies.

If you isolate the major problem to one external device, place toroid cores or split beads over the lead from the computer. Do this right at the exit point from the computer. Also, if the affected device is itself an active generator, a monitor for example put beads right where the leads come out of it. Watch the "S" meter for any change - this tells you if you are getting somewhere. Also, if the device has a power cord or a telephone cord put beads on them. Always remember that telephone and power wires can conduct interference outside your residence and near your antenna.

Split beads usually are the best for computer RFI. The cables have big connectors that won't go through a reasonable size toroid. Removing the connectors to slip on a toroid and then rewiring the connector is a lot of work and you might make a rewiring mistake and get into real trouble. Split beads are great! And they are effective from 1-1000 MHz. Just be sure that the two halves of the bead fit tightly together.

If a bead reduces but does not eliminate an interference signal, try more beads. If one is good, two are better. In stubborn cases add capacitors. A capacitor from a lead to a ground converts the bead into a low pass filter. Use ceramic disc capacitors of .001 to .01 mfd. In a multi-wire cable one bead serves all but you will need a capacitor to ground from each wire.

Each interference problem is different. You have to try this and then try that until you find a solution. Using the principles outlined here, ferrite beads and toroids can be extremely helpful.
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Editor's Note: **Here's an interesting & important question and answer that popped up:**

Q. What is the best place to insert such devices? Is it at the antenna, as the article recommends? What would be wrong with putting it at the transmitter? Isn't a series resistor still a series resistor, as long as it's anywhere between the source and the load?

A. The balun must be right at the antenna. It is not in series between the source and load. Coaxial cable acts like a 3 wire cable: 1) The inner conductor, 2) The inside of the shield, and, 3) The outside of the shield. The power flows through 1 & 2. Due to skin effect the current on wire 2 (inside of the shield) does not penetrate the shield and flows only on the inside. This leaves the outside of the shield free to carry a different RF current. The current coming up the inside of the shield is supposed to go to one side of the antenna but there is nothing to stop it from flowing down the outside of the shield. Without a balun some part of the current will flow down the outside. The balun prevents that by presenting a resistance (or an inductance) to this path. If the balun is down at the transmitter this current can flow that far and thus will radiate. The balun does not affect the path between transmitter and antenna; just this unwanted current path on the outside. Ferrite bead baluns are only practical as 1:1 ratio. Ferrite transformer baluns can be made also in 4:1, 9:1 etc.

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